FAA AVIATION NEWS

JULY 1973

COVER:
The perennial summertime thriller: the air show.
See page 8.

FAA AVIATION NEWS

DEPARTMENT OF TRANSPORTATION/FEDERAL AVIATION ADMINISTRATION VOL. 12, NO. 3

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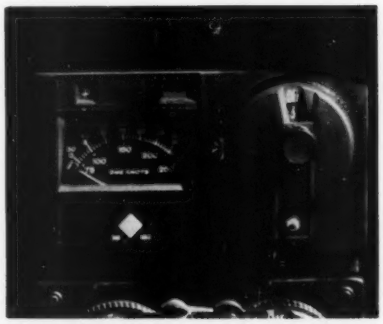

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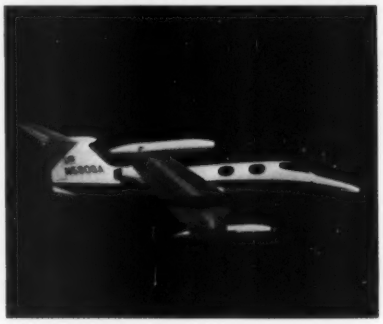

The impossible dream. Page 12

Claude S. Brinegar, *Secretary of Transportation*
Alexander P. Butterfield, *Administrator, FAA*
Louis J. Churchville, *Director of Public Affairs*

David Gelfan, *Editor*
Gernot Rasmussen, *Art Director* Ruth Taksel, *Assistant Editor*

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The New Look in Flight Service

The next decade will see a tenfold increase in FSS facilities and computer assisted briefing systems.

The year is 1979—or thereabouts. The place is the sky over western Montana. The pilot is you, sitting in the cockpit of your single-engine aircraft with family aboard and headed for a Canadian vacation at Banff and Lake Louise. The weather is not exactly CAVU, but the traces of clouds on the horizon seem normal for the midsummer afternoon, and give you no reason for concern. So you sit back and admire the profile of the Blackfoot Mountains and the broad expanse of Flathead Lake below.

At that very instant a weather satellite, invisibly high in the upper stratosphere, has transmitted a photo to the National Weather Service receiving station on earth. A few minutes later, a taped voice on the VOR you are tracking broadcasts a warning of a severe thunderstorm moving north above the Canadian border at a rapid pace. This is the first you have heard of a storm up ahead, and you don't like the idea at all. You wonder if you increased your airspeed and started your descent earlier you might slip in ahead of it . . . but you decide to check with the nearest FSS hub.

The hub is over 200 miles away, but the remoted VOR receiver picks up your transmission and puts you in immediate contact with the flight service station. ". . . this is Cessna Seven Three Seven Foxtrot VFR for Banff, I heard there's some weather making up in front of us. Have you any idea how close it is to my flight path? We're just west of Flathead Lake at 7,500."

You expect to be told to stand by, but your answer comes back almost immediately.

"Banff is reporting a ceiling of 1,000 feet with increasing precipitation, visibility one half mile, thunderstorms with heavy rain showers, wind, 200 degrees at 20 knots."

"How long ago was that?"

"It's the current weather. Seven Three Seven Foxtrot, would you like to have the weather at Kalispell Airport?"

"Uh . . . yes, I would."

You learn that Kalispell is still clearly VFR, so you decide to go where the going is good and land there. En route you ask the hub how early you can pass through Canadian Customs tomorrow morning, and you also check on some points regarding international regulations that you are hazy about. The next morning you continue your

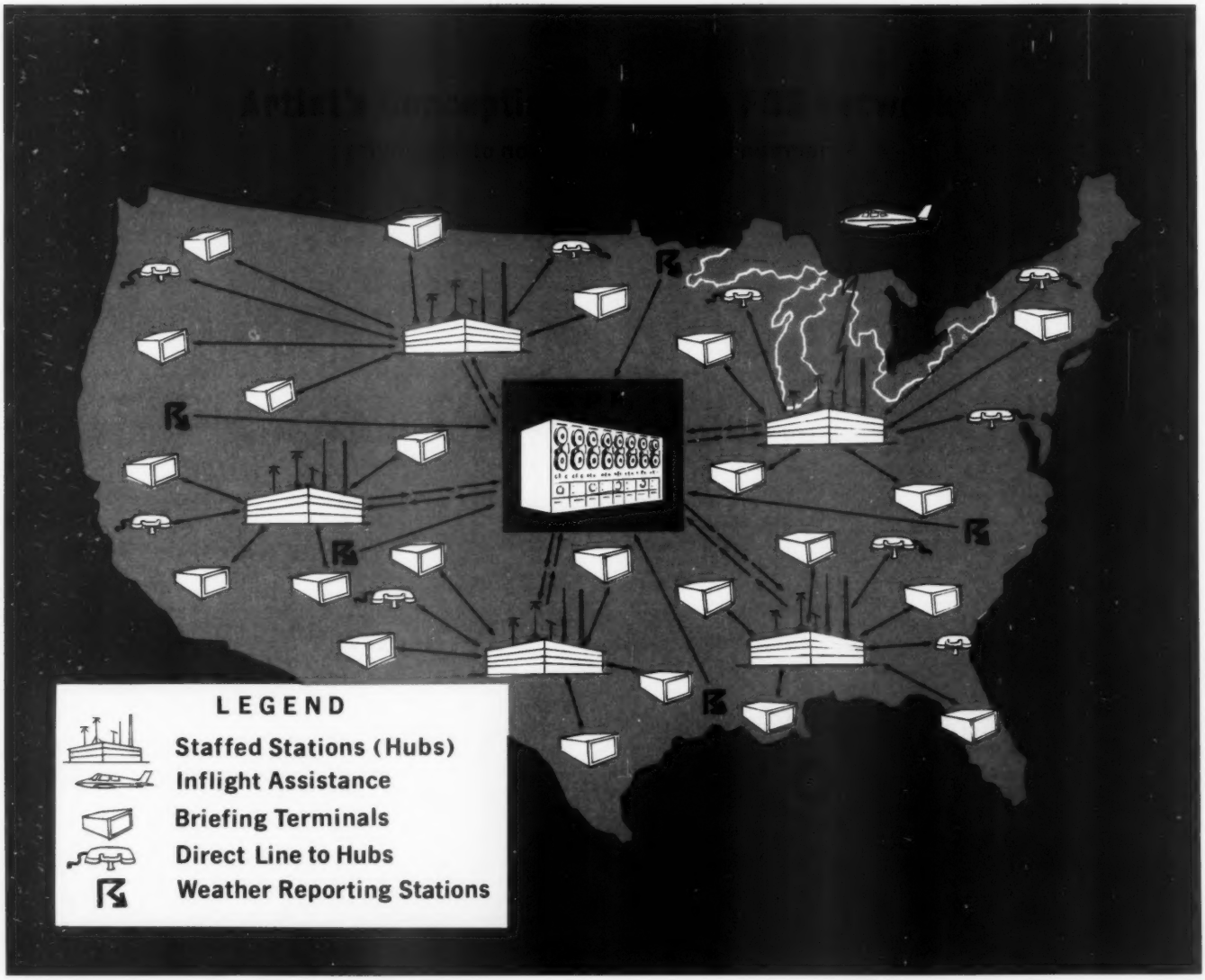
flight in safety and comfort.

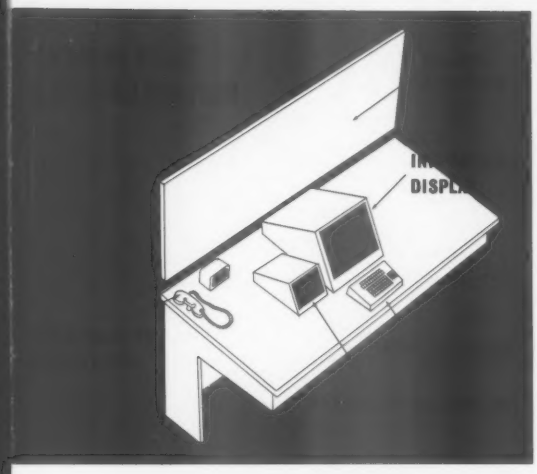
The difference between a safe arrival like this and a hazardous brush with weather often is due to the manner in which the pilot keeps up with possible weather changes en route. The pilot who does not bother to get a terminal forecast or report before committing himself to a destination airport is assuming that no change in the weather has occurred since he took off—an assumption that can be fatal. To make certain that in the next decade, when the pilot population is expected to nearly double, no pilot will be out of range of vital weather data, FAA has begun a thorough revamping of the flight service station system with an emphasis on modern, automated data acquisition and dissemination. The next five years will see a series of transitional changes which will serve as a prelude to the complete transformation to an automated system expected to emerge by 1984.

The "brain" of the new system will be one or more huge, centrally located, computerized processing facilities, capable of receiving, storing and transmitting flight data pertinent to all sections of the country with electronic speed. A central processing facility will be concerned chiefly with weather information derived from automatic weather reporting stations. Instead of depending on reports from individual weather stations and contract observers, as at present, the FSS system will receive continuous reports from strategically located weather monitoring equipment, in the form of digitized data. The raw data, supplemented by PIREPS and statistical data, will be processed at a FSS central processing facility and fed out over land lines to some 3,500 flight service facilities, at 2,500 airports which serve approximately 96 percent of general aviation traffic.

The great majority of these stations will be un-manned, self-briefing stations, where a pilot will be able to obtain specific weather information for his flight, as well as other necessary flight information, study charts, and file his flight plan. The pilot will be provided with a keyboard which, when appropriately punched, will display on a cathode-ray tube type of "TV screen" weather forecasts (in "plain language"), terminal and en route current weather conditions, NOTAMs, etc., as well as selective information from the Airman's Information Manual. The pilot will also be able to use a keyboard to file his flight plan, which will be acknowledged if properly filed, and otherwise rejected. If the pilot has a problem or question that requires a discussion with a FSS specialist, he will be able to telephone directly to a staffed station.

The staffed stations, or "hubs" as they are referred to in the present planning stage, will be few in number, probably between 30 and 50. Their staffing will be adequate to





Important link in the FSS system chain of service will be the self-briefing station—at least one at every public airport—where a pilot can call up a readout of the latest data applicable to his intended route of flight.

handle all air-to-ground communications without delay. Furthermore, the specialists involved will be able to provide pilots with the desired information much more rapidly than is presently possible, since the specialists will also have keyboard consoles with visual readouts similar to those at the self-briefing stations. The hubs will have a vast network of telephone lines to VORs and remote receiving and direction finding stations, so that they will be able to communicate with aircraft several hundred miles away. They will accept PIREPS, changes in flight plans and offer flight assistance, including weather information and interpretation.

The new system will offer many advantages to general aviation pilots, including:

1. **Better access to briefing materials.** The number of briefing terminals will expand tenfold, from 300 to 3,500 within the adjacent 48 states.

2. **More information specifically useful to individual pilots will be available.** The pilot's direct access to computer-stored information, via the cathode-ray tube display screen, will relieve him of the burden of carrying little-used information around in his head—or in his briefcase. He can instantly clarify procedures he may be hazy about.

3. **Faster, better inflight assistance.** As relatively few FAA specialists will have to be involved in pre-flight briefing, thanks to the self-briefing stations, more specialists will be available to respond to aircraft already airborne. (At some of the busier FSSs today, dozens—sometimes hundreds—of calls from pilots cannot be immediately answered, owing to lack of sufficient personnel or frequencies.)

4. **More up-to-date weather reporting.** Automated weather observing will replace periodic observations by individuals at many observation points. Cathode ray tube displays of the weather data will eliminate many of the delays in handling and duplicating teletype printouts. By simply pressing one or two keys on a console, it will be possible for the pilot or the FSS specialist to display weather at any point in the country. If there is a change in the report while it is being copied or read to the pilot, the pilot will learn of the update at once.

5. **Cost savings.** Several generations of pilots have grown up accustomed to receiving flight services from the Federal Government without charge. However, with a pilot population now estimated at over 760,000, some 4,000 FSS personnel are now needed to maintain and staff present facilities. The cost of providing adequate flight service has begun to skyrocket, and some of these costs will have to be borne by users of the airspace system, in addition to the burden shouldered by taxpayers at large. For example, in fiscal year 1974, to maintain the current standard of flight services with the present system, an additional 1,000 specialists would have to be added to the rolls, for a total annual payroll of about $75 million. At the end of a decade this figure would approach 12,000, with an annual payroll of about $180 million. On the other hand, the planned automated system will not only reduce the payroll to $29.1 million annually, but will also provide for an expansion of service and facilities on a broad scale, in keeping with modern technologies of weather observing and communicating—thus insuring the continued natural growth of aviation.

Consequently, the new flight service system will benefit users of the national airspace both as pilots and as taxpayers. The new system will evolve through several stages over the next ten years. The first step, already taking place, is the consolidation of some of the least-used flight service stations with busier stations, resulting in greater service capability with the same number of personnel. Within the next two years, the 300 existing FSSs will be reduced in number to about 146 modernized and expanded flight service stations, to be called Group II stations.

Other changes scheduled to take place during Phase I of the implementation program (fiscal years 1973 through 1978), which will offer clearly discernible benefits to pilots, are:

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- Development, through extensive field testing of prototypes and analysis of user comments, of a thoroughly satisfactory self-briefing terminal station.
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Phase II (1979 through 1984) will see the establishment of a fully automated flight service system and the complete phasing out of the existing system. Considering the fact that some 145 million flight services are expected to be requested of FAA during that year, automation of the system will come none too soon. ■

SYSTEM COST COMPARISONS
($ MILLION)

	PRESENT 1971	PRESENT 1983	PROPOSED 1983
CAPITAL COSTS			
COMPUTER & DISPLAYS	—	—	23.9
FIXTURES & EQUIPMENT	—	25.2	10.6
AV-AWOS (aviation automatic weather observing station)	—	—	24.9
TOTAL	—	25.2	59.4
ANNUAL COSTS			
OPERATIONS PERSONNEL	58.5	178.4	29.1
BUILDINGS	2.0	5.5	1.8
LEASED COMMUNICATIONS	3.9	4.0	14.4
MAINTENANCE & EXPENDABLES	11.3	30.9	9.5
OVERHEAD	10.5	32.0	4.6
TOTAL	86.2	250.8	59.4

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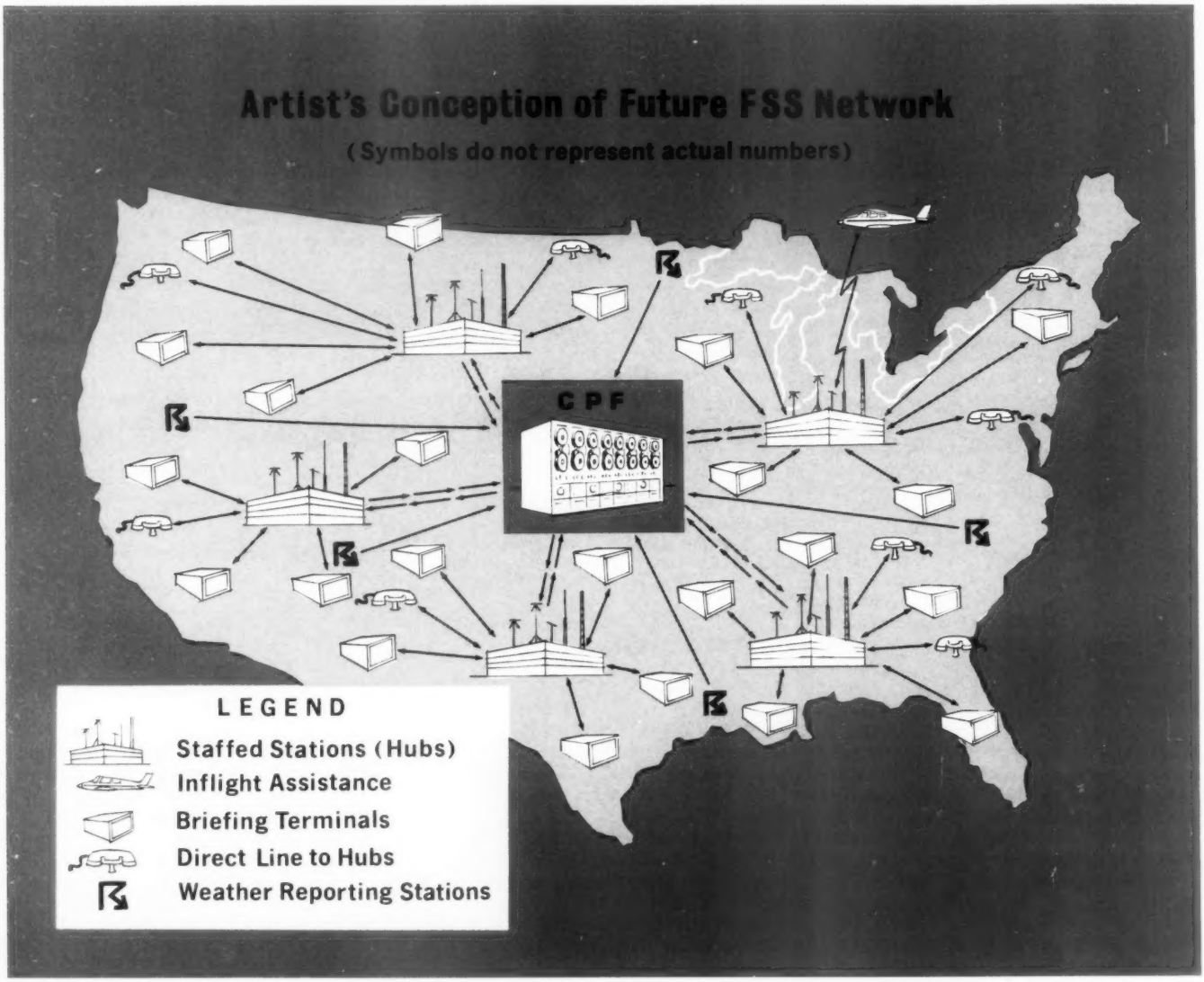

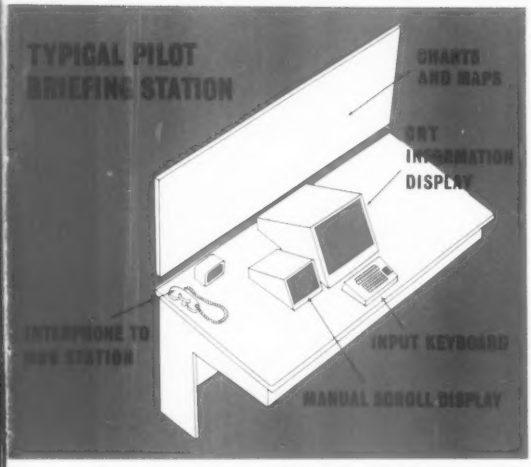

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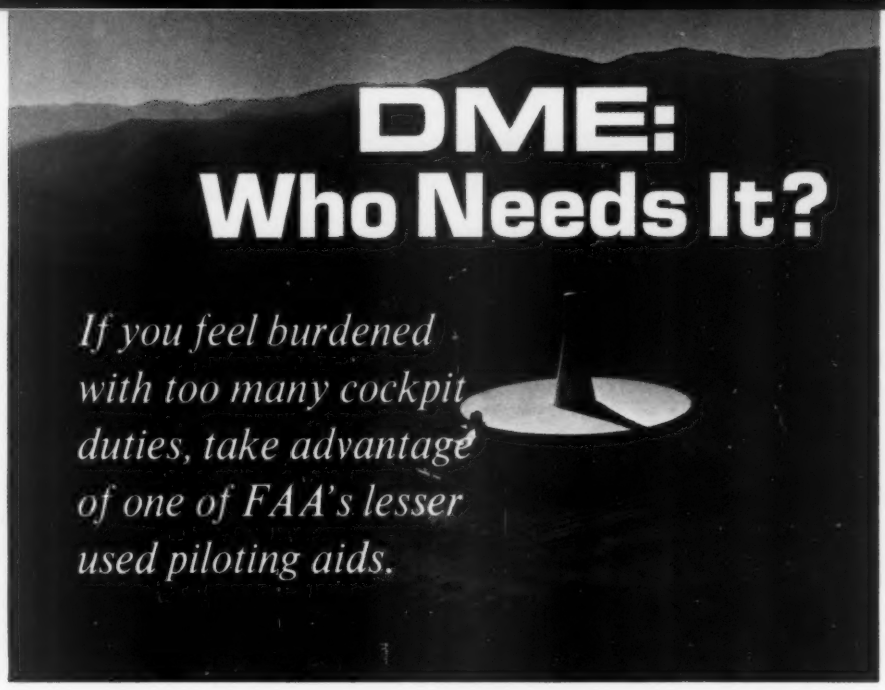
DME: Who Needs It?



If you feel burdened with too many cockpit duties, take advantage of one of FAA's lesser used piloting aids.

Distance measuring equipment (DME) was first installed by the Civil Aeronautics Authority (predecessor of FAA) along U.S. airways in 1950, and the corresponding airborne instruments were quickly acquired by air carrier and other commercial aircraft. General aviation acceptance of DME followed. However there are still some aircraft owners who have the impression that DME is an unnecessary gadget, strictly for instrument flying—and not even needed for that by a competent pilot who knows his business. There are also some rental pilots around who are not familiar enough with the benefits of DME to use it in aircraft which have it available.

The fact is that modern airborne distance measuring equipment is not only simple to learn to use, but it is also capable of making flying much more comfortable, pleasant—and safe—for the VFR pilot as well as the instrument pilot. To disregard it is to ignore the assistance of a navigation aid which is strategically located and carefully maintained throughout the country by FAA, and which can spell the difference between a pilot's ability to land at an airport of his choice or a less desirable alternate.

For the VFR pilot, DME will help you locate your position over the ground rapidly, will confirm your tentative eyeball identification of a landmark, and permit you to spend more time looking outside of the cockpit. Many general aviation type DME's also indicate groundspeed. For the IFR pilot, DME will help you locate fixes (especially handy at unfamiliar airports), add accuracy to VOR approaches, and enable you to operate into some airports under weather conditions that would bar a non-DME equipped aircraft.

Airborne DME will work in conjunction with any VOR ground station which has either DME instrumentation or Tactical Air Navigation (TACAN). TACAN is a military navigation system which provides both directional guidance and distance information to military aircraft; *only* the distance measuring component has been integrated by FAA into the civilian system, so that any DME-equipped civilian aircraft can derive this data from a TACAN that is co-located with a VOR ground station (VORTAC). Thus, a VORTAC uses two technically different systems to provide directional information to civilian and military pilots, and offers distance information to both with the integrated DME system. Purely civilian DME needs are provided for at certain ground stations, usually terminal VORs or ILS localizers or glide-slope transmitters.

DME furnishes distance information with a high degree of accuracy. It must be remembered, however, that DME distance is slant-range distance rather than actual horizontal distance, and an aircraft flying at 10,000 feet above the ground will "read" about two miles out when passing directly over the station.

Not all VOR stations are equipped for DME; to find out whether a given VOR will give you a DME reading, check the symbol on the sectional chart:

- VOR
- VORTAC
- VOR/DME

On the sectional chart if the airport and VOR station are co-located, so that the airport symbol covers the center of the compass rose, then there will be an indication at the top of the identification box which will clue you in, as follows:

An added clue that a station is equipped with TACAN or DME is that together with the VOR frequency in the identification box there will be a channel listing (example: Ch 88). This is the frequency channel used by military planes to tune to the station.

The installation of the TACAN network has just about stabilized, with few new ones being added except where airports or airways are added or relocated, or where high density traffic dictates a need. There are presently about 700 TACANs at VOR sites; FAA's long-range plans call for a total of 721 by 1982. On the other hand, the DME system is an expanding one. There are presently 13 DMEs at VORs; FAA's ten-year-plan calls for about 120 by 1982, including 11 low-power, solid state versions at TVORs (Terminal VORs). The use of DME stations coordinated with instrument landing systems (ILS) is also expected to increase considerably from the present 11 to more than 100 in 1982. Additionally, the TACAN/DME network will play an integral part in the area navigation (RNAV) system which is envisioned for the future.

The DME works on a question and answer principle, somewhat like the transponder. Paired pulses at a specific spacing are sent out from the aircraft (this is the interrogation) and are received at the ground station. The ground station transmits paired pulses back to the aircraft at the same pulse spacing but on a different frequency. (This is the reply.) The time required for the round trip of this signal exchange is measured in the airborne DME unit and is translated into distance (nautical miles) from the aircraft to the ground station. Utilization of the changing time factor gives the groundspeed on units so equipped.

Although regarded by some VFR pilots as a luxury, DME makes a very positive contribution to flight safety by reducing the mathematical computations required to determine groundspeed. The decreasing visibility in many sections of the country due to smog or other types of air pollution causes many pilots to feel a need for more constant scanning in flight, and the DME affords them additional time to look around. The instrument is also capable of saving a pilot from the embarrassment of landing at the wrong airport, when no positive identification from the air is available. When approaching a busy terminal area, the DME-equipped pilot will often find it much more helpful to give his position as so many miles out on a given radial, than "over the golf course" (*which* golf course?). Having distance and groundspeed constantly available is helpful in estimating ETA, and also aids in choosing the VFR altitude where the winds are most favorable, and in calculating fuel consumption.

DME is even more useful in instrument flight, and in making IFR approaches. Just as the transponder advises the radar operator exactly where an airplane is, so does the DME (plus VOR) inform the pilot just where he is in relation to a station. The

DME can help the instrument pilot in identifying airway intersections and holding patterns. Authorized DME intersections are shown on government charts by an open arrowhead symbol: (15)→ and on Jeppesen charts by the letter "D".

The true magic of DME becomes evident in an instrument approach. The DME adds a new dimension and a lot of precision to the VOR approach, for example, as is evidenced by the lower weather minimums you can use on many approaches if the aircraft is DME-equipped. With DME you know just where you are on the VOR radial all the time; without DME you must lean heavily on your stopwatch and your estimated groundspeed, and then the result is an educated guess, at best.

Instrument approaches using DME fall into two classes—those in which operating DME equipment is *required*, and those where DME is convenient and useful, but is *optional*. In the first type if either the airborne or ground equipment fails (VOR or DME) the approach cannot be completed. In the "optional" class if the DME equipment fails the approach can be continued, but with higher minimums. If the name on the approach chart contains the letters DME, then the equipment is required. This distinction would also be reflected in the box of "minimum altitudes" on the approach chart. If there are separate minimums for DME-equipped craft it is possible to make that approach without the equipment, using the higher minimums.

Another means of using DME in an instrument approach is by flying the "DME arc" around to the final approach, which can be a VOR radial or a localizer course. The DME arc, which is appearing with increased frequency on instrument approach procedures, appears usually as a partial circle around the VORTAC. When using such an approach you may be cleared to "intercept the ten-mile DME arc." Instead of maneuvering your way around a procedure turn you fly on the arc around the station, keeping your DME reading pegged on ten until you reach the final approach course, then you turn in and fly directly to the airport.

It will take approximately a 90 degree turn to get onto the DME arc or to leave it for your final approach, so you should anticipate the lead you will need to roll out on the proper heading. For groundspeeds below 150 knots, a half mile lead is normally about right, presuming a standard-rate turn.

If you are flying an instrument approach procedure that incorporates a DME arc to a localizer the lead radial will be shown on the chart. Lead radials from opposite directions are not always symmetrical. On the current plate for Greater Cincinnati ILS Rwy 9, for example, the lead for a right turn into final is 3 degrees, for a left turn 13 degrees, the difference being due to the fact that the DME station is not at the airport, but off to one side.

While there is nothing new or different about intercepting a VOR radial or a localizer course from a 90-degree angle, maintaining a smooth DME arc does take some practice. The trick is to fly the arc in a series of short, straight-line segments, with 20-degree heading changes, rather than attempt to fly an unbroken circle, it would be excessively attention-consuming if you tried to keep the DME reading at a constant ten miles. You need to closely monitor the omni bearing selector and the course deviation indicator or needle, of the VOR receiver, as well as the DME reading which gives you the arc distance. It is important to keep a continuous mental picture of your position, relative to the facility. Larger arcs are easier to fly than small circles, of course, and slower speeds are easier to handle than high speeds.

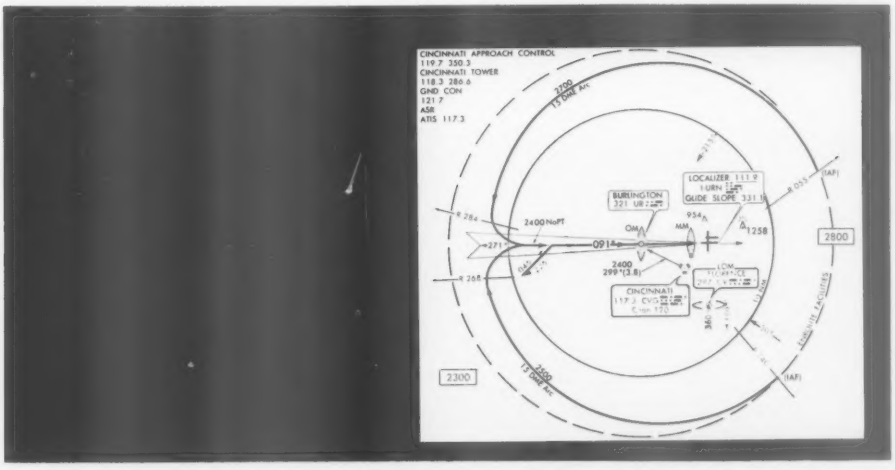
In the illustration shown, the aircraft flying inbound on the 325 degree radial from the OKT VORTAC is planning to intercept and turn left onto the ten-mile DME arc. The pilot monitors his DME reading closely, and as it reaches 10.5 miles he begins a 90-degree left turn, to 055 degrees and turns his omni bearing selector to 335 degrees. If the rollout places the aircraft on the arc, the DME will read 10.0 NM. The omni needle will center shortly, meaning that the aircraft is crossing the 335 degree radial. Now he sets the OBS 20 degrees ahead, to 355 degrees, and turns his aircraft 20 degrees to the right, to a new heading of 75 degrees. He holds this heading until the 355 degree radial is crossed, at which time, if the maneuver is perfect, the DME should read 10.

Maintaining the arc is simpler if you stay slightly inside the curve, because then you are flying *toward* the arc and can intercept it by just continuing to fly in a straight line. (During the flying of the arc, at the midpoint of the straight segments, the DME will read slightly less than 10.) It is possible to fly the entire circle in this manner, by continuing to set the OBS radial 20 degrees ahead and turning your craft 20 degrees for each segment of your quasi-circular course. Usually, however, an IFR approach will require you to fly only part-way around—to the final approach course. If there is a strong wind you will need to correct for it when you are flying crosswise of its direction.

Flying a DME arc is greatly simplified if the aircraft is equipped with a Radio Magnetic Indicator (RMI) which has a needle that points directly to the VORTAC. When you are established on the arc, the needle will be pointing toward a wingtip, 90 degrees to the right or left of the aircraft nose. With an RMI you need not be concerned with the VOR indications until the final approach course is reached. You use the RMI and the DME mileage reading. As you complete a flight segment the RMI needle moves toward the tail; when it has moved about ten degrees you change your heading some 20 degrees, until the RMI needle is five to ten degrees ahead of the wingtip reference. You maintain your heading until the pointer is again behind the wingtip, and repeat the process around the circle, watching that the DME reading stays at or near the ten-mile mark. Of course all these procedures can be used in reverse to fly outbound from a DME station to an enroute course.

As with all precision flight maneuvers, flying a smooth, consistent DME arc requires diligent practice, but is well worth while, because it can save the pilot time, and give FAA's Air Traffic Service additional flexibility in spacing inbound traffic. In fact, installing the relatively low-cost, low-power, solid-state DMEs at locations where there is non-radar approach control is part of FAA's future plans for improving the airways.

(A recent FAA Advisory circular on Flying DME ARC discusses these procedures in detail. AC 90-62 is available without charge from the DOT/FAA Distribution Unit, TAD 484.3, Washington, D.C. 20591.)



Left—interception of a DME arc. Right—lead radials (284° and 268°) are shown on an ILS approach chart which offers pilots a 15-mile DME arc to intercept the localizer.

For more than half a century air shows have been introducing Americans to the excitement and wonders of aviation.

There were three fatal accidents at Dulles Airport near Washington, D.C., during the air shows which were part of TRANSPO 72. In one of them a pilot with the Air Force *Thunderbird* team experienced mechanical failure with his jet and ejected but landed directly on his burning airplane; in another, an experienced stunt man was flying aloft in a kite when he suddenly lost altitude and was dashed to the ground; and in the third accident a pilot of a small plane was killed in a mid-air collision during a closed course race. Three deaths within the space of a few days.

Just how dangerous are air shows?

Since 1938 the Federal Aviation Administration and its predecessor Federal agencies have regulated air shows by requiring that waivers be issued for each individual aerobatic performance, and that the spectators be protected at all times against harmful consequences of any possible accident. The success of this policy can be seen in the fact that not a single injury to an air show spectator during a show has occurred in the past 35 years.

The FAA "General Aviation Operations Inspector's Handbook" clearly states the agency's basic philosophy about air shows: "The processing inspector's primary responsibility is to make sure that spectators, other persons and property on the surface, and air traffic (non-show traffic) will not be endangered by the air show or any act in that show."

The very nature of aerial exhibitions makes a flight accident always a possibility. Whenever aircraft performance, new designs and pilot skills are tested as thoroughly as they are at many of the shows, the consequences of maintenance or piloting error can be serious and indeed fatal. Nevertheless, FAA regulation and monitoring of the shows has done much to change them from dramatic death-defying acts to demonstrations of the ultimate in piloting skill and control.

The method which the FAA uses to insure safety at air shows is a two-fold one: the requirement for a waiver certificate which permits the air show; and the presence of at least one inspector from the local GADO to monitor the show during its entire duration.

The application for the certificate of waiver must be made at the local GADO office prior to the beginning of the air show. In it the sponsor of the show must give a rather detailed description of the proposed program and the safety features he will employ. He must, for instance, indicate his spectator control program, which is usually accomplished by a designated spectator area, roped off and policed by a local law enforcement agency.

He must also show how air traffic control will be managed during the course of the show. He must indicate what emergency facilities he will have on hand, such as a rescue squad and professional medical people. And he must submit a chart of the airport which shows the acrobatic area "dead line"—a prominent landmark, such as a runway or a road or a constructed sign, which identifies the line beyond which flight operations are prohibited during the show.

Furthermore, this application must list the various events which are to be performed, and each aircraft must be identified by make and model, identification mark, name of the owner and his address. Each pilot's name and certificate number must be listed. When the GADO inspector is reviewing the application he frequently knows the acrobatic capabilities of many of the more celebrated stunt flyers; he may also accept the certificate of competency which has been issued by another GADO office. The certificate of competency gives the make and model of the airplane which the acrobatic pilot is qualified to fly, and the minimum altitude at which he may perform.

Today many GADO inspectors are accepting the Aerobatic Certificate of recognized aerobatic clubs or societies, which can only be gained after a thorough and rigorous acrobatic demonstration, to the satisfaction of that organization's safety examiners. Whenever the GADO inspector has the slightest doubt or lack of knowledge about a pilot's acrobatic proficiency he can, and frequently does, require an actual demonstration of the pilot's routine before the show begins.

When the local GADO finally issues the waiver certificate it includes a detailed outline of the various restrictions which must be followed during the show. The "Inspector's Handbook" lists one set of standard limitations which must be included in every waiver; these are only minimum limits and they may be increased if the GADO feels that local conditions warrant it. Some of

e Roar of Crowd

these standard limitations for all air shows are:

- There must be at least 1,500 feet of separation between the "dead line" and spectators for all acrobatic aircraft operating at speeds in excess of 130 knots cruising airspeed. A 500 foot separation is allowed for aircraft operating at lower speeds.
- Spectators must be at least 200 feet away from active runways or other landing and takeoff areas.
- Spectators must be kept at least 100 feet from areas where engines, propellors, or rotors will be turning up.
- A parachute landing target may not be permitted closer than 250 feet to a spectator area, and then only if the approach area and overshoot area are free of all spectators.

In addition to these standard limitations, the waiver certificate also lists a number of special provisions for each particular air show, such as the minimum altitude allowed for vertical bank maneuvers, stalls, etc. Finally the waiver requires a pre-show briefing session attended by all participants in the show. At this session all the provisions of the waiver are explained to the people involved, who must sign a statement which certifies that they have understood and will comply with the terms of the waiver.

During the actual air show there must be at least one monitor from the GADO in attendance, to make sure that all provisions of the waiver are being followed. If the situation warrants it, the monitor has authority to terminate the waiver on the spot, thus closing the show immediately. This is a rare occurrence. However, FAA monitors, not infrequently, will stop the show temporarily when spectators begin to wander from the designated area, weather conditions deteriorate, or some unforseen condition prevails that might lead to an accident.

The presence of the FAA monitor at air shows is a pretty fair guarantee that the pilots are not going to attempt any unauthorized stunts which might endanger people's lives. The exuberant voice of the announcer may suggest that the pilot in the sky is about to attempt some hair-raising feat which has never been done before—but the fact is that the exhibition has always been well planned in advance and approved by an FAA inspector.

At larger air shows more than one monitor is frequently required. At the Reading, Pa., show this June for instance, there were six FAA monitors on hand: three in operations and three in maintenance. The Reading Municipal Airport normally has about 350 operations a day, but during the air show each June it may have as many as 3,300 in a single day. At the recent show the tower added seven temporary FAA air traffic controllers for a total of 17 controllers on duty. At the close of each day of the show, when hundreds of small planes departed the field in a short space of time, tower controllers set up stations near the active runways to speed the flow of traffic and prevent "fender bending" accidents.

Some 500 air shows take place every year throughout the United States. Some have national significance, others are state and county affairs, with chiefly local interest. Attendance ranges from a few thousand spectators to several hundred thousand—the Experimental Aircraft Association's annual convention and show at Oshkosh, Wisc., attracts a crowd of almost half a million persons during the week-long show. Numerous "Flying Circuses of World War I" have sprung up around the country, with performances given weekends during the summer. Regardless of the size of the show, each must have an FAA waiver, and at least one FAA inspector must be on hand during the show.

Every now and then a show is darkened by an air tragedy. A pilot may exceed the load limits of his airplane during a maneuver so that it breaks up in flight. An item on a pre-flight checklist may be glossed over, so that an airplane takes off with insufficient fuel, a jammed flight control, or the wrong fuel mixture. In one particularly unfortunate accident in 1969, the control stick in a J-3 Cub was not properly connected before take-off, leading to a fatal crash. The pilot had 10,000 hours of experience, over 3,000 in the Cub. Air show accidents, however infrequent, point up a sober lesson to all pilots: no one who flies, no matter how experienced or skillful, can ever afford to be careless.

No one is accident-proof. ■

The Reading Air Show in western Pennsylvania, a major annual event for general aviation, attracts thousands of attendees, hundreds of airplanes. **Far left**—Marvin Bortz, control tower chief, oversees FAA controller activities during busy June week at Reading. **Second left**—GADO Supervisor John Doster checks on fire-rescue field preparations. Safety of spectators requires adequate room for sky watching and for examining planes on the ground. **Far right**—cautious toddler admires Bell 206 *Jet Ranger* from a respectful distance.

Weather Whys:

Occluded and Stationary Fronts

This is the fourth article in a series prepared by the National Weather Service for FAA.

Every front is a boundary between relatively warm and relatively cold air. The cold front and the warm front, which were discussed in May and June, are the two primary types. But there are variations, known by other names, that affect the safety of flight.

The six symbols used on weather maps to identify fronts are:

- COLD FRONT (SURFACE)
- WARM FRONT (SURFACE)
- OCCLUDED FRONT (SURFACE)
- STATIONARY FRONT (SURFACE)
- UPPER WARM FRONT
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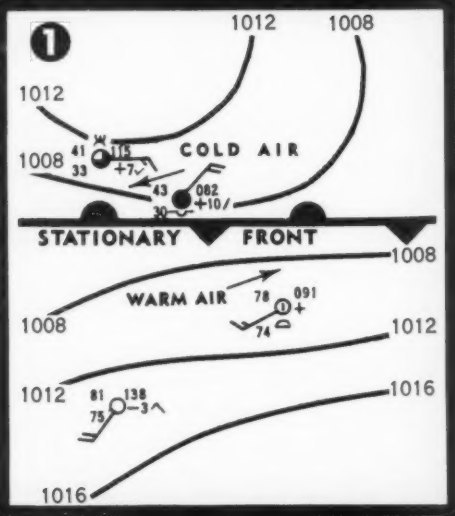
Occluded, stationary, and upper fronts are merely warm or cold fronts in different positions. They cause the same flight problems as the basic fronts. The pilot must give each frontal system individual consideration, because no two are exactly alike and any one may be dangerous.

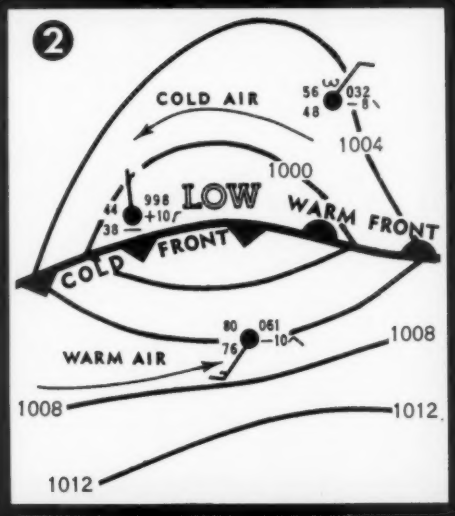
Two of these—stationary and occluded fronts—can be understood by studying the life cycle of a frontal wave system as it might appear on the surface weather map.

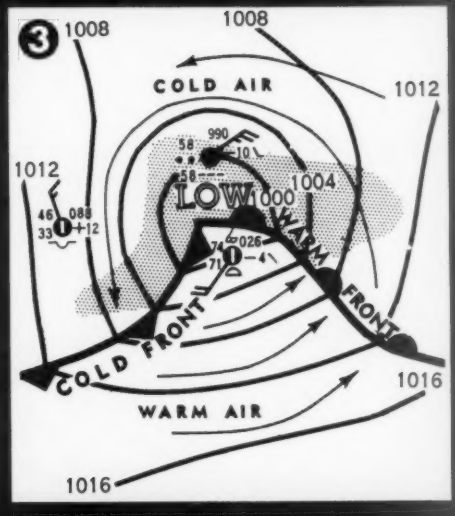
The stationary front (figure 1) either does not move or shows no pronounced movement in a definite direction. On one side the air is cold; on the other side the air is warm. Surface winds tend to blow parallel to the front.

Weather conditions along stationary fronts, although similar to those associated with warm fronts, are generally less intense and not so extensive. Nevertheless, they can hamper flight operations for extended periods. Cloudiness, precipitation, and poor visibility may persist in one area for several days. This type of front is especially common along the eastern slopes of the Rockies in winter months.

Often, after a moving front becomes stationary, it will continue to weaken and eventually will dissipate. On the other hand,







a front that has remained stationary for several days may suddenly begin to move. It then becomes a warm front or a cold front.

The stationary front shown *(figure 1)* is approximately straight, although surface fronts actually present many irregularities. In *figure 2*, a small irregularity has grown into a small wave on the front. A new low-pressure circulation or wave-cyclone is forming.

Plotting unit of electronic weather computer plotter automatically draws contours of pressure at specified heights from numbers on magnetic tape. Northern hemisphere map, 20"x30", is drawn in less than three minutes.

A wave-cyclone is a center of low pressure that moves along a front like a sea swell and creates waves in the front resembling waves in the ocean. Small in the beginning, a wave grows *(figures 3 and 4)* until a "whitecap" is formed *(figure 5)*. Later, it diminishes and dissipates *(figure 6)*.

At the crest or whitecap stage, the wave-cyclone undergoes a process known as *occlusion*. The cold air portion of the wave, traveling faster than the warm air ahead of it, overtakes and forces the warm air aloft. From this point on, the front at the surface is called an *occluded (closed in) front*. Although the air at the surface is cold on both sides of the occluded front, *the warm part of the wave still exists some distance above the surface, causing large areas of cloudiness and precipitation.*

In an occlusion, the front between the warm air aloft and the cool air below does not intersect the surface; it is therefore called an *upper front*. Upper fronts present problems to the pilot and the pilot briefer. Their locations are difficult to determine from surface observations. They may be ahead of the surface position of the occluded front or they may be behind it. Moreover, upper fronts are not easy for pilots to identify in flight because their associated cloud layers are hidden by the clouds of the surface system.

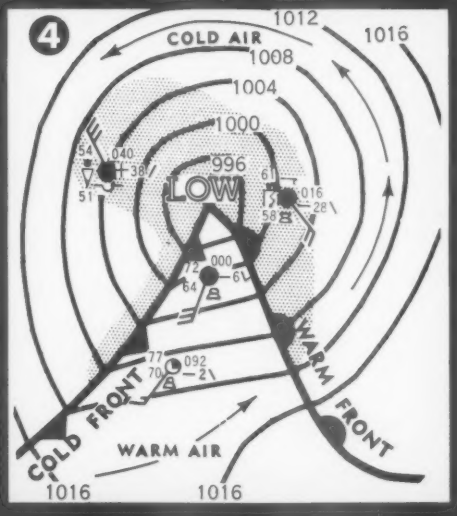
The structure of the occluded front and the locations of associated weather depend on the temperature difference between the cold air in advance of the front and the cold air behind it. If the air in advance is colder, the air behind will flow over it. The resulting weather will occur in advance of the occluded front as it does with a surface warm front. If the air behind the front is colder it will lift the air ahead of it. The weather produced will then be near or behind the occluded front, as in a surface cold front.

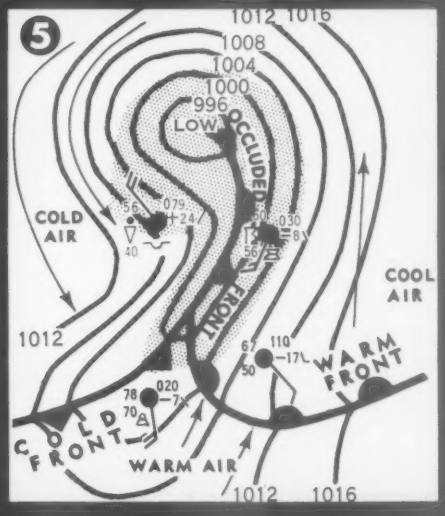
Occlusion is a process of decay, heralding the death of the entire storm system. In its early stages, however, enough energy remains to produce very hazardous weather over an area extending from 50 to 100 miles outward along the occlusion. ***A weatherwise pilot will avoid this area which often contains all the worst features of both warm and cold fronts, including turbulence, icing, precipitation and thunderstorms.***

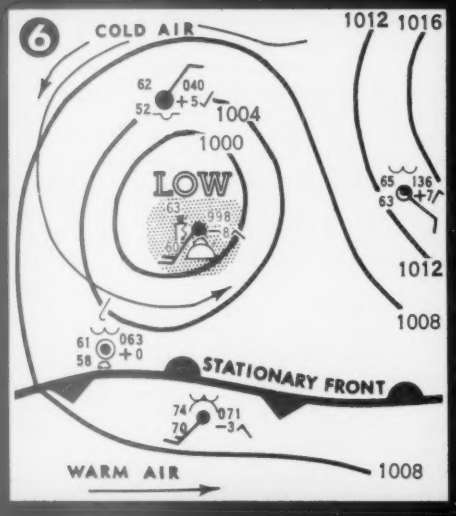
When occlusion reaches its final stages, the temperature contrast within the low pressure center decreases, frontal characteristics disappear, clouds gradually decrease, and the atmosphere returns to its undisturbed state. The low pressure center which has accompanied the atmospheric wave loses its cyclonic, or counterclockwise, circulation and fades into the larger air mass circulation.

Upper fronts are warm or cold fronts aloft in the atmosphere. They do not intersect the earth's surface. Upper fronts occur in the occlusion process as described above.

During the winter months, another type of upper front is frequently found to the east of the Rocky Mountains. Cold fronts from the Pacific Ocean move eastward over the mountains and across the Plains states. At upper levels, the Pacific air is colder than the air it replaces. Close to the ground, the snow-covered Plains have created a very dense layer of cold air. The Pacific air rides over the lower, colder air. Such upper fronts often move for long distances and dissipate without ever touching the surface. ■







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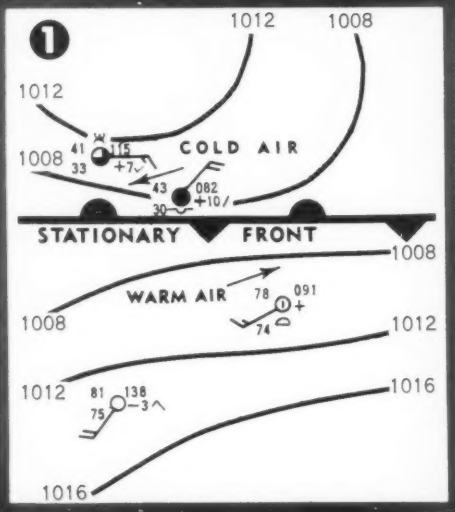

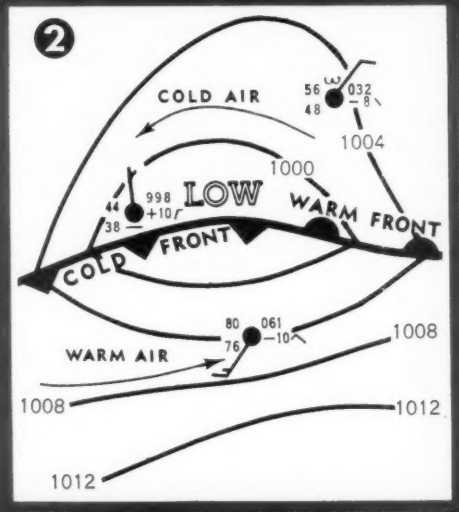

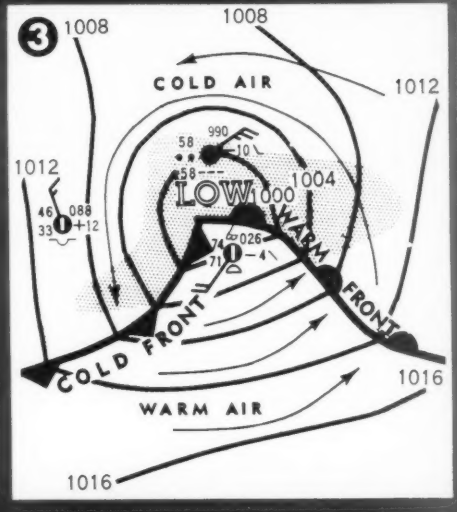

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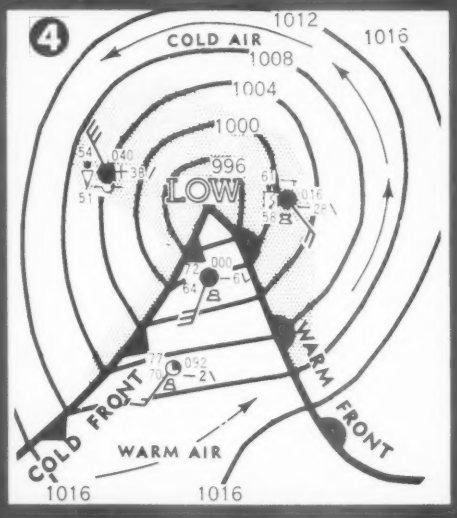
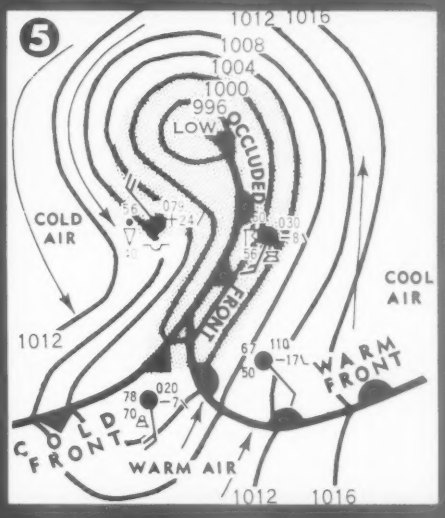
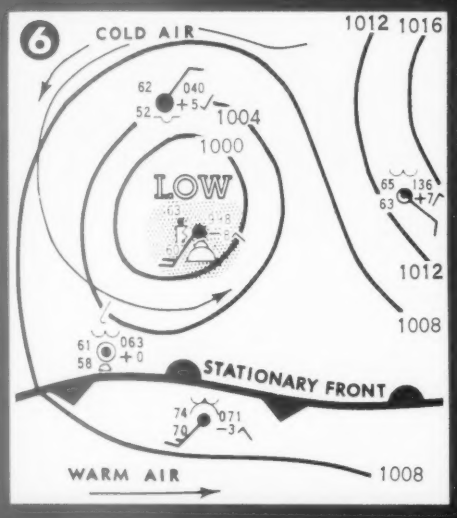
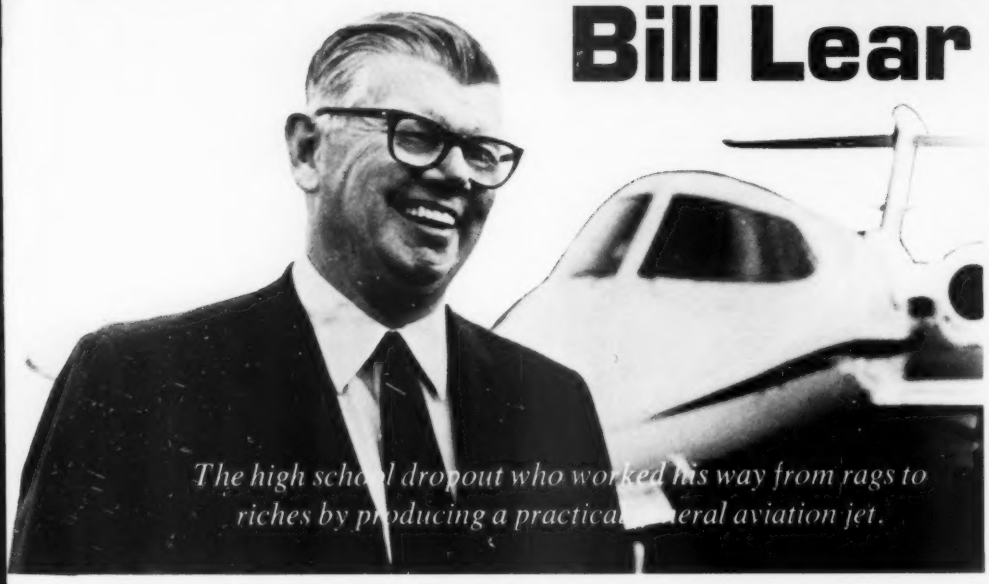






Famous
FLYERS

The Extraordinary Bill Lear



The high school dropout who worked his way from rags to riches by producing a practical general aviation jet.

The aviation career of William Lear, designer of the Lear jet and prolific avionics inventor, reads like the classic Horatio Alger story.

Young Bill started out as a shoe shine boy on the streets of Chicago, quit school after the eighth grade, taught himself to fly at age 17, and began to work on a series of electronic and aerodynamic inventions. He eventually compiled almost 150 patents which have made him a millionaire many times over, and which have helped put private flying on a par with commercial air travel as regards speed and degree of sophistication.

Born in Hannibal, Mo., in 1902 (an only child), Bill moved with his mother to South Chicago at an early age, after his parents separated. Money was scarce in the household and before he was ten young Lear had worked at a number of after-school jobs to help out. In 1912, when the news of the *Titanic* disaster came crackling out of hundreds of early radios, Bill was fascinated by this marvel of electronics. He began to spend every available moment in a neighbor's basement, which had a collection of odd radio parts. At the age of 13 he was able to build his own battery charger, and promptly invested his scanty capital into business cards which read: "Batteries charged—25¢."

The enterprising boy soon had another business operation which he carried in his pocket: a slab of carbon. He had observed that nearly every stalled automobile he encountered had a faulty carbon brush in the distributor. Roving repairman Lear would whittle a new brush out of his slab of carbon and fit it in the distributor; almost invariably the car would start. Service charge: $2.00.

At the age of 15 he ran away from school and home, hitchhiking through the Midwest with a suitcase full of radio parts, earning his livelihood by doing radio repairs. A year later, in 1918, he misrepresented his age and joined the Navy. He was stationed at the Great Lakes Training Center, where he received his only formal instruction in electronics.

Discharged at age 17, he attended a Lincoln Beachey air show at Ashborn Field, and when he saw those fantastic planes diving and spinning through the air he immediately decided to become a flyer. He received about an hour's verbal instruction from a pilot, and then he simply rented an old Curtiss *Jenny* and took off—into an amazing aviation career.

Electronics provided the stepping stones for his involvement in aviation. At 19 he opened his own radio laboratory in Quincy, Illinois, and during the 20's, he patented a number of highly important inventions, including one of the first non-battery home radios, and the first practical automobile radio.

In 1930 he founded Lear Developments, based in Santa Monica, Calif., to produce avionics equipment for aircraft.

Space and weight was a problem in the aircraft of that time, but in 1932 Bill produced the Lear "Radioaire", a small set the size of a shoe box which became the first two-way radio for use by general aviation.

In 1935 he developed the "Lear-O-Scope," the first commercial aviation radio direction finder with visual left-right indication; two years later came the "Learmatic Navigator," which automatically solved complex navigational problems for the pilot.

By 1940 his firm was employing 1,500 technicians and 320 scientists and engineers. During World War II his firm produced more than $100 million dollars worth of military avionics. Near the end of the war he was challenged to develop a navigational system for the new fighter jets. It was a perplexing problem, because the only autopilots then in use were heavy and cumbersome.

After flying over 3,600 hours in all sorts of airplanes—C-47's, C-60's, C-45's, B-26's and *Bonanzas*—and in all kinds of weather to study the pilot's needs, he produced a compact 25-pound device which provided an automatic pilot and automatic approach control-coupler system for jet aircraft, the F-5, later modified into the "Lear L-2" for small general aviation aircraft.

President Truman presented Lear the prestigious Collier Trophy in 1950 for the greatest achievement in aviation during the previous year. The citation read, "Without the F-5 the jet aircraft of the United States Air Force more than probably might have been without an acceptable solution to the problems of operationally safe night flying, blind flight, automatic tracking, and all-weather landing."

Lear avionics expanded into Europe, and in 1960 he received the Great Silver Medal from the City of Paris for his design of a autopilot which was used in the completely automatic landings of a *Caravelle* airliner.

But there was one other aviation need which had been tugging at his mind for some time: the development of a high speed, reasonably-priced executive airplane. It was in Switzerland in 1961 that he discovered the concept he thought he could use; a light jet military interceptor, the P-16. The plane had been bugged with equipment design problems, so the Swiss were dissatisfied with it. Lear hired some of the P-16 team, and started to work on designing his own plane, moving the operation to Wichita, Kansas. His jet was developed during a furious 13-month period of round-the-clock work. One engineer remembers that "the only way we knew it was Sunday was that the newspaper was heavier."

Lear personally supervised every single aspect of the construction of the jet, even to weighing each part and insisting that engineers prove that they were absolutely essential before *he* would approve them. He cut the weight of the seats in half, designed a radically new 42 inch door and new instrumentation, and he developed scores of special lightweight components. He used to say during the construction, "I'm the board of directors around here, and every five minutes I have a board meeting in my mind."

On October 7, 1963 the *Lear Jet* was ready for its maiden flight. It weighed 13,500 pounds, cruised at 560 mph, and could seat eight people. It had been produced to sell at a cost of $649,000, which was about $400,000 less than its nearest competitor. It soon became the world's most popular executive jet.

In 1963 Lear put on the duck-billed blue cap he wears for flying and took his new plane up by himself. He put it through a

full series of maneuvers and it performed perfectly—not to his surprise, for he said later, "I'd already flown that jet a thousand times in my mind."

In 1967 he sold his company to Gates Rubber of Colorado for around $28 million, doubling the return on his original investment in five years.

But 1967 was a bad year for Lear in other ways. A blood vessel broke in the rear of his active brain, and for nine seconds he lay on an operating table without heartbeat or respiration, dead for all practical purposes. He did recover, but he had to endure a long and immobile recuperation during late 1967 and early 1968.

Back on his feet, he purchased something he had always wanted: his own airfield. He bought an abandoned military field, Stead Air Force Base, near Reno, for the sum of $1.35 million, and he established yet another new firm, "Learavia," which specializes in automatic flight controls. Lear still works in the firm today, and he is now planning a retrofit of the wing on his original Lear jet: a "super-critical" wing which will allow for coast-to-coast operation in the high subsonic range with low landing speeds. He is also at work on what he says will be the world's most advanced autopilot, smaller and lighter than any autopilot yet developed and suitable for any size of airplane.

At 71, Bill Lear is vigorous and hearty, and looks years younger than his actual age. He still flies his own *Lear Jet,* averaging about 50 hours of cockpit time a month. Last spring he flew to Washington, D.C. to talk to a senate committee about his latest invention: a steam turbine engine which he contends will produce only 1% of the exhaust emission of the present internal combustion engine. An experimental steam propelled bus and car have been finished, and are now being reduced to production prototypes.

There are people who say that Lear's new engine will not work, but he has been hearing that all his life, and nothing has stopped him yet.

Sleek of line, light in weight, relatively low in cost—these were some of the features Lear demanded for his revolutionary business jet. Maiden flight took place in Wichita in 1963.

Pilot BRIEFS

■ RECYCLING RETIRED WARBIRDS. Guidelines for obtaining standard civil airworthiness certificates for surplus military aircraft or aircraft built from spare and surplus parts are included in a new FAA Advisory Circular, which lists basic eligibility requirements, conformity methods, and step-by-step certification procedures. It also itemizes several critical areas of concern in "civilianizing" ex-warbirds. The Department of Defense assumes no liability for aircraft sold as surplus to meet FAA airworthiness certification requirements, it is up to the purchaser to have the aircraft certificated for civil use. "Standard Airworthiness Certification of Surplus Military Aircraft and Aircraft Built from Spare and Surplus Parts", AC 21-13, is available free from DOT/FAA Distribution Unit, TAD-484.3, Washington, D.C. 20591.

■ AIRPORT CERTIFICATION rules are being expanded to include airports serving supplemental air carriers and other CAB-certificated operators, or serving as their refueling stops. FAA is charged with setting safety standards for all airports serving certificated air carriers and this is the second step in that direction. Some 500 terminals served by airlines operating large aircraft (over 12,500 lbs.) on regular schedules have already been certificated, and as many as 200 smaller airports may be effected.

■ MARKED FOR DAMAGE: Aircraft owners are cautioned that marking the skin of an airplane with a pencil can cause corrosive chemical reaction. A dramatic example occurred when an inspector drew a pencil line around a crack in an aluminum wing skin on a military plane. A couple of months later the crack lost its importance because the entire disc fell out. If it is necessary to mark aircraft skin check with an aircraft mechanic to find out what materials are safe, or use chalk, which is harmless.

■ WEEKEND PILOTS AND THE ENERGY CRISIS. General aviation vacationers should be alert to the possibility of a shortage of aviation fuel and plan their flights accordingly. At some resort areas pilots have arrived only to find they were unable to get fuel for their return flights. Flyers should take special care in flight planning and fuel management and to check ahead to be sure fuel is available at their destination airports or refueling stops. FAA reminds pilots that the aircraft should not be fueled with automobile fuel under any circumstances since it may do serious damage to the engine.

Florida Man Wins Airplane in Safe Pilot Sweepstakes

A 51-year-old, 120-hour private pilot who realized a life-long ambition to learn to fly only a year and a half ago (after putting two daughters through college) was named winner of a $30,000 airplane of his choice in the Safe Pilot Sweepstakes sponsored by the General Aviation Manufacturers Association in support of the FAA General Aviation Accident Prevention Program. Ward Woodbury, Ph.D., a music professor and symphony orchestra conductor at Winter Park, Fla. has not yet decided what type of aircraft he will choose from among the 27 available models and almost endless combinations of avionics, but his active pursuit of an instrument rating will probably have some bearing on his decision.

FAA Administrator Alexander P. Butterfield (left, photo) made the presentation at a Pilot Seminar in Long Beach, Calif. on June 14. All persons who had participated in the FAA Accident Prevention Program during the previous year by attending an FAA Pilot Educational Seminar or clinic were eligible for the drawing. Other prizes were also given, including a non-pilot prize of a $1,500 certificate for pilot training.

First of 12 Group II TCAs Proposed for St. Louis Area

The first of 12 Group II terminal control areas (TCA's) planned by FAA has been proposed for the St. Louis area. To operate within the Group II TCA, pilots would need two-way radio and VOR or TACAN receivers. Transponders would not be required for VFR traffic but would be needed for IFR flights. Student pilots are not restricted from flying in a Group II TCA. Flights into the Group II TCA would need an air traffic control clearance and pilots would be required to follow ATC instructions. Sequencing and separation service would be provided by radar. For VFR pilots who have become accustomed to using the Stage III radar advisory service, which is presently available at St. Louis for vectors and sequencing of VFR traffic, the principle difference in using the Group II TCA is that pilot participation would be mandatory and a clearance would be required to enter.

The TCA design proposed for St. Louis is circular, with an outside radius of 20 miles and a ceiling of 8,000 feet. The floor starts from the ground at the airport, and stairsteps up to 4,500 feet at the outer ring. No effective date has been set.

The St. Louis TCA proposal was discussed at a public meeting with users from the area in February, 1973. Comments on the proposal (Docket #73-WA-8) should be submitted to the FAA, ACE-500, 601 E. 12th St., Kansas City, Mo. 64106, by August 20, 1973.

TAKING TOP HONORS at the 25th annual air meet of the National Intercollegiate Flying Association were Mauri Banycke Norman (left) of Southern Illinois University, and Mike Kreller of Louisiana Tech, who won trophies as top U.S. college pilots. Bonnie Smith (right) of Auburn University received the Ninety-Nines Achievement Award. The meet was held at Carbondale, Ill.

ATC Automation of Radar Underway at Los Angeles, Kansas Centers

The air traffic control automation program moved a step forward recently when the Los Angeles Air Route Traffic Control Center—followed almost immediately by the Kansas City Center—began field testing radar data processing equipment. For properly equipped aircraft this radar system displays on the scope altitude as well as position and identity. Under the old system aircraft location is shown on the radar but identification and altitude must be confirmed by voice. This is the first use of a digital radar processing system for en route aircraft although similar equipment (ARTS III) is in use at a number of terminals. The new equipment is expected to be in use at eleven centers by the end of this year, and at all 20 centers by mid-1975. When radar data processing is completed at all centers and at the major terminals the air traffic control system will be a semi-automated, nation-wide integrated system.

The first phase of the en route automation program was completed last February when the Memphis center joined the other 19 centers in a nationwide computer network for the automatic transfer of flight data from one facility to another.

Rule Would Allow Personal Oxygen

A rule change proposed by FAA would allow passengers to carry their own approved oxygen supply aboard aircraft if they have a written statement signed by a licensed physician. At present the carriage of oxygen, other than that for in-flight emergencies, is prohibited in the passenger compartment. The new rule would allow patients who are dependent on oxygen equipment to travel by air, and would provide for safety standards in oxygen handling.

Comments on the proposal (Docket 12169, Notice #73-19) should be submitted to FAA, AGC-24, Washington, D.C. 20591 by August 17, 1973.

Number of GA Airports Rising

The number of aircraft landing facilities in the U.S. continued to grow in 1972, with a year-end total of 12,405 airports, heliports and seaplane bases. This is a net increase of 335 over the previous year. Included in the total were 10,846 airports, 1,098 heliports and 461 seaplane bases. The 1972 increase was achieved despite the fact that 435 landing facilities were reported abandoned in that year.

Of the total, 4,481 facilities are publicly owned, and 7,924 are privately owned and operated (4,920 of the latter are closed to the public). Texas leads the states with 1,167, Alaska has 766, California 754, Illinois 749.

FAA Aviation News welcomes comments from the aviation community. We will reserve this page for an exchange of views. No anonymous letters will be used, but names will be withheld on request.

• Idle Choppers?

Is FAA doing anything to help police agencies acquire and use surplus military helicopters which are sitting idle in storage? The Pentagon has reportedly promised to provide all available records on the crafts, but I understand in some cases their acquisition is being delayed because the FAA must certificate them before they can be used.

N. B. Boye
Redding, Calif.

FAA field offices have been instructed to put forth every possible effort, within the manpower available, to assist police agencies in certificating surplus military aircraft.

Such certification is by no means always a simple matter. Any aircraft that is not known to conform to a civilian type certificate is potentially a hazard in civilian use. Establishing such conformity is often complicated by such factors as missing aircraft records and log books, replacement parts that are unidentified or made by firms without civil production approval, etc. Sorting out all the records and tracing the history of parts is the responsibility of the purchaser, and even with FAA help does take time. There is no short cut to safety.

• On Plug-Swapping

In January you described a test of an engine which was designed for 80 octane gasoline, but which was run for 500 hours on a higher-octane fuel. I feel this article was misleading and incomplete, since you do not state the model number of the engine tested or the number of hours the photographed spark plug actually had run on the wrong fuel. In my opinion mis-matching octane numbers is a bad deal anytime, and your suggestion for swapping the bottom plugs with the top ones could cause dangerous problems; loaded plugs should be rejected immediately. In the old days this was a temporary make-do procedure for getting out of a pasture back to a maintenance shop.

Thomas B. Couper
FAA Accident
Prevention Counselor
West Orange, N.J.

The 500-hour engine evaluation mentioned in the brief was made by Champion Spark Plugs and submitted to the Aeronautical Center in Champion's Aviation Technical Bulletin, Number 71-6. This was one spark plug manufacturer's suggestion for handling the problem.

Obviously, new or properly cleaned and gapped plugs should be used as replacements when available. However, there should not be any objection if the engine operates satisfactorily with interchanged plugs.

The fuel designated for your engine should be used whenever possible. If the octane fuel recommended for the engine is unavailable, a higher (rather than lower) octane fuel must be used. Limitations provided by the engine manufacturer should be followed when using the higher octane fuel. Additional information on this subject is also discussed in FAA Advisory Circular 91-33, available free from DOT/FAA, TAD 484.3, Washington, D.C. 20591.

• A Stitch in Time

After reading "Wet Landings" in the October 1972 issue, I'd like to recommend that airline-type safety precautions be required for light aircraft used over water. There should be a placard, like the airlines have, in the back of each seat giving instructions for a water emergency. If I ever have such an emergency, I am not going to have time to give detailed instructions to the five passengers in my Cherokee Six.

A passenger briefing should be mandatory, yes, but a "life boat drill" prior to each flight would be unrealistic. It would be better to have the manufacturer supply useful placards. Also, how about some safety engineering on light planes to provide quick releases for door handles, spaces for underseat life vests or flotation cushions, signalling equipment, provisions, etc. And new FARs to require maintenance on survival equipment.

Hugo D. Freudenthal
Massapequa, New York

The recommendations will be considered. FAA is currently proposing rulemaking action which would require manufacturers to eliminate certain potentially hazardous cabin features (see the March news page of FAA AVIATION NEWS).

• British View of A & P Ticket

May I add a slight correction to your description (Forum, March issue) of the British Civil Aviation Authority's view toward the American Airframe and Powerplant certificates?

We accept an A & P license as an indication of basic engineering knowledge of aircraft and engines, but we require holders of this license to pass the relevant examinations that will satisfy us that the applicants are specifically knowledgeable about the equipment they will be working on—as well as familiar with British aeronautical regulations.

Laurence S. Edwards
British Civil Aviation
Authority

• Lighting OMNI Stations

I am wondering if it would be helpful to install lights on OMNIs as a further aid to pilot orientation at night?

Joseph R. Seborowski
Baltimore, Md.

We do not believe that lighting OMNI stations would be feasible as an added aid to pilots at night. Except where obstruction lighting is necessary, the addition of other lighting, as proposed, would be costly and would be of questionable use to pilots. It might even be confusing since there are so many other lights used for ground and air navigation purposes.

• A Plug for Plugs

I read the article "Audible Warning" in your October 1972 issue and the subsequent comments in the Flight Forum concerning the value of earplugs and an inquiry as to where the plugs can be obtained. If your readers will write to me I will be glad to send them information on some plugs that work very well for me and my flight students.

Fred Salomon, CFI
17028 136th Pl. SE
Renton, Wash. 98055

• ELT Facts

For the past two months I have been trying to get some honest data on the performance of emergency locator transmitters (ELT's) from FAA, first the GADO, then headquarters, but I have been getting the usual bureaucratic runaround. A fellow in your Washington office reported there was high percentage of success with ELT's but I believe I have heard of more failures than that. I have also been unsuccessful in finding out how many planes with ELTs have not been found. I *know* that FAA is thorough enough in their accident investigation so that they know which ELT's have been functioning and which have not. These things are important to me since I am in the process of selecting an ELT.

Leo J. Fiebiger
University Park, N.M.

Only you can tell which ELT is best for your purposes. FAA does not *test hardware or compile performance records for the purpose of recommending specific brands or models. FAA* does *establish standards and administer the TSO system where it is applicable, as with the ELT. All ELT's presently TSO'd under TSO-C91 meet the requirements of our minimum performance standard. There is presently no requirement for reporting ELT successes or failures, so we learn only of those incidents that are voluntarily reported. There is not enough data on hand to do more with than indicate personal preferences. Talk to pilots who have used ELTs in your area.*

• False Alarms

With the emergency locator transmitter (ELT) coming into common use, I have some questions. If an ELT activates inadvertently on an airfield, who is responsible for locating the offending transmitter? How is it done? Once located, how is it shut off? If the owner of the aircraft is absent do you break into the aircraft? Just what do you do?

R. Frank Qualliotine
Fayetteville, N.C.

Notify either the nearest FAA facility or the local police. They will know who has the nearest equipment to locate an activated ELT. They will also know who has the authority to enter the aircraft, if that proves necessary to shut the transmitter off. Individuals (including FAA personnel) could be guilty of breaking a law if they forcibly enter a locked aircraft.

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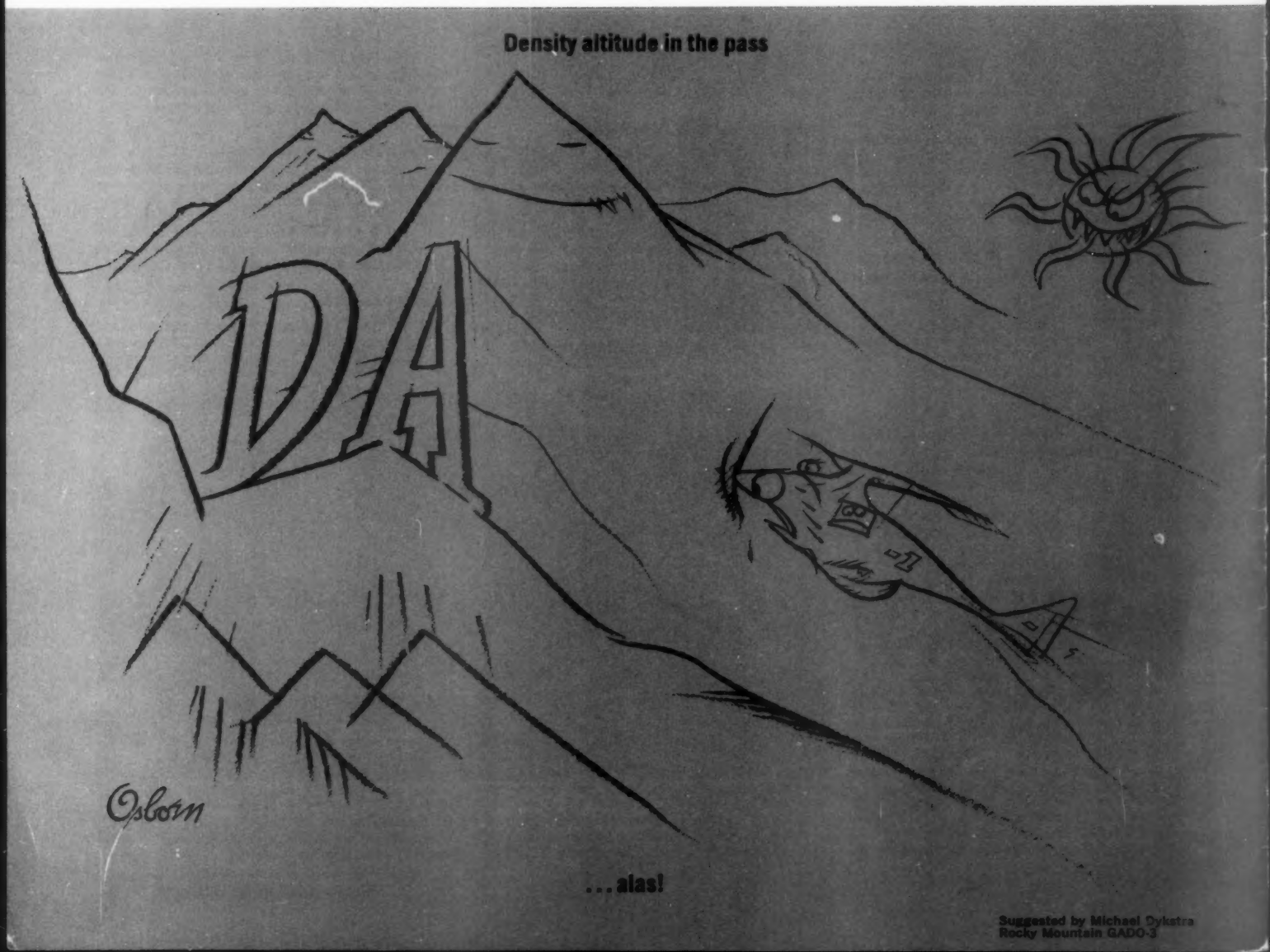

Suggested by Michael Dykstra
Rocky Mountain GADO-3